

A Comprehensive study to Fetal Weight Measurement with Clinical Methods and Ultrasound and Correlation

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ABSTRACT:

Introduction: Accurate estimation of fetal weight is of paramount importance in the management of labor and in predicting the survival of the baby outside the uterus. The perinatal and maternal outcomes grossly depend on the fetal weight at term gestation⁽¹⁾ and management of diabetic and post-cesarean pregnancies is greatly influenced by the accurate estimation of fetal weight⁽²⁾. Different methods of estimating fetal weight have been tried in different parts of the world in search of the best method. A quick clinical method of fetal weight determination in utero will also be useful to paramedical staff working in rural areas to decide regarding referral to higher centres.^[3] **Aim:** To evaluate the accuracy of fetal weight estimation by clinical and sonographic methods. **Methods:** This is prospective , observational study carried out in a tertiary care hospital in Department of Obstetrics & Gynaecology of T.N.M.C & BYL Ch. Nair hospital, Mumbai over a period of 18months. It was a prospective study covering 200 pregnant women at term gestation. **Results:** In our study entitled ‘A Comprehensive study to Fetal Weight Measurement with Clinical Methods and Ultrasound and Correlation’ estimation using Ultrasonography was found to be more accurate and reliable in estimating the actual fetal weight among term pregnancy. However, the reliability of an Ultrasound machine depends on the quality of the machine and the skill of the sonographer.

Keywords: *Fetal birth weight, Hadlock’s method, Johnson’s formula, Macdonald’s formula, Dawn’s formula*

INTRODUCTION:

In modern obstetrics, to deliver a healthy baby to a healthy mother is the primary goal. Birth weight is one of the most important factors which determines the neonatal outcome and survival.⁽⁴⁾ So, the accurate estimation of fetal weight is one of the important aspects in management of labour.⁽⁵⁾ In the high-risk conditions such as intrauterine growth restriction (IUGR), previous lower segment cesarean section, and macrosomia, fetal weight greatly influences management of the labor and delivery by timely interventions.⁽⁶⁾ Low birth weight babies which include small for gestational age babies, intra uterine growth restricted babies or preterm babies are associated with increased perinatal morbidity and mortality. Large babies which include large for gestational age or macrosomic babies of diabetic mothers, may land up with labour complications like brachial plexus injuries, facial palsies, birth canal injuries, post-partum haemorrhage⁽⁷⁾ Abnormalities in fetal growth can be detected clinically or by Ultrasound. Simple methods like measurements of symphysio-fundal height (SFH) and abdominal girth (AG) can be used to predict expected fetal weight in low resource settings.⁽⁸⁾ Ultrasound is also used for estimation of expected fetal

weight and diagnosis of impaired growth. But it is not easily available in all places offering obstetric care, especially in low resource settings. In such circumstances clinical methods of estimating fetal weight can aid in obstetric decision making.⁽⁹⁾ This study has been aimed to compare the accuracy of the three clinical formulae viz, Johnson’s, McDonald’s and Dawn’s formula to assess fetal weight and compare with Ultrasound estimated fetal weight and actual birth weight among full-term pregnancies in early labour.

Aim: To evaluate the accuracy of fetal weight estimation by clinical and sonographic methods.

1. To estimate the fetal weight in term pregnancy by clinical methods.
2. To estimate the fetal weight in term pregnancy by ultra sound.
3. To compare the result of above with actual birth weight (ABW)

METHODS:

This is prospective observational study carried out in Department of Obstetrics & Gynaecology of T.N.M.C & BYL Ch. Nair hospital, Mumbai over a period of

18months. The ethical committee of T.N.M.C & BYL Ch. Nair hospital approved the study. In our study 200 Antenatal women at term (37-40 weeks) pregnancy were included. Patients were selected based from the following selection criteria Primigravida or multigravida, Live Singleton pregnancy with Cephalic presentation. All Cases admitted at ≥ 37 weeks of gestation with intact membranes.with known last menstrual period or Ultrasound scan with confirmed expected date of delivery. The study was conducted after the Ethical committee approval, Since my study is a prospective observational study, 200 patients were selected based on the selection criteria.The expected fetal weight was calculated using the following clinical formulae, Namely,

McDonald’s measurement:

1. EFW = SFH (cms) X AG (cms) at the level of umbilicus.

Fetal weight in grams = Fundal height in cms x Abdominal girth in cms.

2. Johnson’s formula: Fetal weight in grams = (fundal height in centimeters – n) \times 155
n denotes the station of head n = 13 when presenting part is above ischial spines
n = 12 when presenting part is at ischial spines
n = 11 when presenting part is below ischial spines
3. Dawn’s formula: Fetal estimation by Dawn’s formula. The vertical length of gravid uterus is measured from superior border of symphysis pubis to fundus (L) in cm and the transverse diamete at uterine cornu (T) in cm using pelvimeter.
 $W=1.44 \times L \times T^2$

USG METHODS FOR ASSESSMENT OF FETAL WEIGHT:

Hadlock’s Ultrasonographic formula: using ultrasonographic measurements of biparietal diameter, abdominal circumference, and femur length.

RESULTS & OBSERVATION:

Our study consists of 200 Antenatal women at term (> 37 weeks) pregnancy.

Table 1 : Distribution of patients based on Age group.

| Age (in years) | Number | Percentage |
|----------------|------------------|------------|
| <20 | 7 | 3.5% |
| 21-30 | 149 | 74.5% |
| ≥ 31 | 44 | 22% |
| Total | 200 | 100%- |
| Mean (SD) | 27.62 \pm 4.47 | |

In our study majority of the patients were in the age group of 26-30 years. The mean maternal age in our study was 27.62 \pm 4.47 years.

Table. No: 2 Distribution of patients based on parity.

| Parity | Number | Percentage |
|--------|--------|------------|
| Primi | 109 | 54.5% |
| Multi | 91 | 45.5% |
| Total | 200 | 100% |

In our study majority (54.55%) of the patients in the study was Primi gravida and 91(45.5%) Multigravida.

Table. No:3 Distribution of Study Subjects according to the Gestational Age.

| Gestational age(weeks) | Frequency | % |
|------------------------|-----------|-------|
| 37-37.6 weeks | 68 | 34% |
| 38-38.6weeks | 77 | 38.5% |
| 39-39.6weeks | 43 | 21.5% |
| 40weeks and Above | 12 | 6% |

In our study majority 77(38.5%) of the subjects had their delivery at the 38th week of gestation, followed by 39th week of gestation 43(21.5%).

Table No 4: Distribution of Subjects according to the mode of Delivery.

| Mode of delivery | Frequency | % |
|-------------------------|-----------|-------|
| Normal vaginal delivery | 119 | 59.5% |
| Instrumental delivery | 3 | 1.5% |
| LSCS | 78 | 39% |

From the table it is seen majority 119(59.5%) of the study population had normal vaginal delivery followed by 78(39%) delivered by LSCS and 1.5% had instrumental delivery.

Table No 5 : Mean actual birth weight.

| Sr. No | Estimates | Actual birth weight |
|--------|---------------------------|---------------------|
| 1 | Total No. of Live birth | 200 |
| 2 | Mean actual birth weight | 2928.10 |
| 3 | Maximum birth weight | 4300 |
| 4 | Minimum birth weight | 1500 |
| 5 | S. D – standard deviation | 508.17 |

WEIGHT ASSESSED BY CLINICAL METHODS:**Table no 6: The mean estimated birth weight by clinical methods**

| Sr no | Mean estimated fetal weight by | | Difference between mean estimated fetal weight and mean actual birth weight | Standard deviation |
|-------|--------------------------------|---------|---|--------------------|
| 1 | Johnson method | 3016.81 | 88.71 | 429.06 |
| 2 | McDonald's method | 3075.61 | 147.51 | 429.06 |
| 3 | Dawn's method | 2803.17 | 124.93 | 552.55 |
| 4 | Ultrasound | 2913.96 | 14.14 | 485.02 |

Table No 7 : Comparison of Mean Birth Weight by Different Methods.

| | Mean | Maximum | Minimum |
|---------------------|---------------------|---------|---------|
| Actual birth weight | 2928.10 (508.17) | 4300 | 1634 |
| McDonalds | 3075.61 (429.06) | 4633 | 2064 |
| Johnson | 3016.81 (429.06) | 4340 | 1860 |
| Dawn | 2803.17 (552.55) | 4345 | 1586 |
| Ultrasound | 2913.96 (485.02) | 4100 | 1650 |

From the above table, it was found that the mean actual weight was 2928 gms. On comparing with the other methods in estimating the birth weight. It was found that birth weight estimation using ultrasound 2913gms was closer to actual weight compared to other methods of estimation.

Table No 8 : Correlation between Actual birth weight with clinical method and ultrasound.

| | Mean | Maximum | Minimum | Correlation |
|---------------------|---------------------|---------|---------|-------------|
| Actual birth weight | 2928.10 (508.17) | 4300 | 1634 | |
| McDonalds | 3075.61 (429.06) | 4633 | 2064 | 0.788 |
| Johnson | 3016.81 (429.06) | 4340 | 1860 | 0.804 |
| Dawn | 2803.17 (552.55) | 4345 | 1586 | 0.744 |
| Ultrasound | 2913.96 (485.02) | 4100 | 1650 | 0.944 |

On applying pearsons correlation to compare between various methods of estimation and actual weight it was found that all methods had a positive correlation in estimating the actual birth weight. Among the various methods of estimation, ultrasound was found to have a strong correlation (0.944).

Table no 9: Comparison of Average Error in various fetal weight groups by Different Methods.

| Methods | ≤ 2500 gm | 2501-3000gms | 3001-3500gms | 3501-4000gms | Overall |
|------------|-----------|--------------|--------------|--------------|---------|
| McDonalds | 582 | 477 | 401 | 290 | 437.5 |
| Johnson | 511 | 398 | 354 | 266 | 382.25 |
| Dawn | 478 | 489 | 439 | 395 | 450.25 |
| Ultrasound | 395 | 278 | 213 | 106 | 248 |

On comparing the average error between various methods, it was found that error was least when estimation was done using ultrasound followed by Johnson's method, McDonald's and Dawn's method from the table we can interpret that the error is least when estimating the birth weight of 3501-4000 gm and the error is maximum on estimating the birth weight ≤ 2500.

Table no 10 : Number of cases with over and underestimate of birth weight by different methods.

| Methods | No. Of cases over estimated | No. Of cases underestimated |
|-----------------|-----------------------------|-----------------------------|
| JOHNSONS | 103 (51.5%) | 97 (48.5%) |
| McDonalds | 113 (56.5%) | 87 (43.5%) |
| Dawns | 139 (69.5%) | 62 (31%) |
| Ultrasound | 83 (41.5%) | 117 (58.5%) |
| p- value | t= 32.096 df = 3 | <0.001 |

It was found that McDonald's, Johnson's and Dawn's over estimate in estimation of birth weight and Ultrasound underestimate in estimating birth weight.

Table no. 11 : Comparison of Mean differences in various foetal weight groups by Different Methods.

| (I)Methods | (J)Methods | Mean Difference (I-J) | Std. Error | p- value |
|----------------------------|-------------------|-----------------------|------------|----------|
| Actual birth weight | Johnson | -88.71 | 30.3392262 | 0.542 |
| | McDonalds | -147.51 | 29.4869393 | 0.098 |
| | Dawn | 124.93 | 39.0717459 | 0.117 |
| | Ultrasound | 14.14 | 34.2967477 | 0.997 |

From the above table, it is clear that, there was no significant difference between actual birth weight and Ultrasound, Johnson's, Dawn's and McDonald's formula to estimate the birth weight. It is inferred that all the methods are more or less accurately estimated the actual birth weight. But, when compared to the four methods, Ultrasound estimate was more accurate than other two methods as the mean difference between Ultrasound estimate and actual birth weight was found to be very less ie. 14.14 g. When compared to other three methods. Thus, it is concluded that, Ultrasound method is more accurate in estimation of birth weight followed by Johnson, Dawn's and McDonald's formulas.

DISCUSSION:

Birth weight of an infant is one the most important determinant of newborn survival. The assessment of fetal weight is a vital and universal part of antenatal care, not only in the management of labor and delivery but also during the management of high-risk pregnancies and growth monitoring. (7,10) The two main

methods for predicting birth weight in current obstetrics are clinical methods and ultrasonographic methods. (11,12)

Demographic Details:

In our study majority 74.5% of the patients were in the age group of 21-30 years. The mean maternal age in our study was 27.62 ± 4.47 years. Majority (54.55%) of the patients in the study was Primi gravida and 91(45.5%) Multigravida.

Mode of Delivery:

In our study majority 119(59.5%) of the study population had normal vaginal delivery followed by 78(39%) delivered by LSCS and 3 (1.5%) had Instrumental delivery.

Comparison of over and underestimation:

In our study majority of the overestimation was seen by using Dawns method (69.5%) followed by McDonald's, Johnsons and ULTRASOUND (56.5%,

51.5%, and 41.5%). On comparing birth weight overestimation, it was least when estimated using ULTRASOUND. Similarly on comparing underestimation in our study, it was highest among ULTRASOUND method (58.5%) followed by Johnson's (48.5%), McDonald's (43.5%) and Dawn's

(31%). Several studies have been conducted in the past comparing the efficacy of various clinical methods of fetal weight estimation with ultrasound and various clinical methods among themselves. In the present study, both clinical and ultrasonographic methods of fetal weight estimation were compared.

Overestimation:

| Author | McDONALD'S | JOHNSONS | DAWN | ULTRASOUND |
|---|------------|----------|-------|------------|
| Current study | 56.5% | 51.5% | 69.5% | 41.5% |
| Kishor P Chauhan et al, ⁽¹³⁾ | - | 68% | 66% | - |
| A Aruna et al ⁽¹⁴⁾ | - | 79% | - | - |
| Sharma R et al ⁽¹⁵⁾ | - | - | - | 20.9% |

Underestimation:

| Author | McDONALD'S | JOHNSONS | DAWN | ULTRASOUND |
|---|------------|----------|------|------------|
| Current study | 43.5% | 48.5% | 31% | 58.5% |
| Kishor P Chauhan et al, ⁽¹³⁾ | - | 32% | 34% | - |
| A Aruna et al ⁽¹⁴⁾ | - | 21% | - | - |
| Sharma R et al ⁽¹⁵⁾ | - | - | - | 11.8% |

In a study conducted by Kishor P Chauhan et al, ⁽¹³⁾ estimation using Dawn's formula showed underestimated of 34% and overestimated of 66%. Similarly on estimating using Johnson's method, it overestimated 68% and underestiamtion32%. In a study conducted by A Aruna et al, ⁽¹⁴⁾ the Johnson's formula overestimated 79% and underestimated 21%. Sharma R et al,⁽¹⁵⁾ conducted a study to estimate the birth weight using Ultrasonography method, it was found the method had 20.9% overestimation and 11.8% underestimation.

Correlation:

In our study on applying Pearson's correlation to compare between various methods of estimation and actual weight it was found that all methods had a positive correlation in estimating the actual birth weight. Among the various methods of estimation, Ultrasound was found to have a strong correlation (0.944) followed by Johnson's, McDonald's, Dawn's (0.804, 0.788, 0.744)

Average error in estimating the birth weight:

| Author | McDONALD'S (Error in grms) | JOHNSONS (Error in grms) | DAWN (Error in grms) | ULTRASOUND (Error in grms) |
|---|-------------------------------|-----------------------------|-------------------------|-------------------------------|
| Current study | 437.5 | 382.25 | 450.25 | 248 |
| Tiwari eat al ⁽¹⁶⁾ | - | 327.28 | - | - |
| Bhandary Amritha et al, ⁽¹⁷⁾ | - | 292.51 | - | - |
| Kishor P Chauhan et al, ⁽¹³⁾ | - | 309.98 | 441.56 | 258.48 |
| Sharma R eat al ⁽¹⁵⁾ | - | - | - | 258.5 |

In our study the error for estimating the birth weight was lowest when estimated using Ultrasound followed by Johnson's, McDonald's and Dawn's. Kishor P Chauhan et al ⁽¹³⁾, conducted a study to assess the fetal weight in term pregnancies by various methods it was found that the accuracy in estimating the actual fetal weight was higher using Ultrasound followed by Johnson's and Dawn's method. Among all the four methods in estimation of birth weight, Ultrasound was found to be more accurate in estimating the fetal weight. Among the clinical method Johnson's formula had more accuracy compared to McDonald's and Dawn's formula. In estimating the fetal weight.

CONCLUSION:

In our study, estimation using Ultrasonography was found to be more accurate and reliable in estimating the actual fetal weight among term pregnancy. However, the reliability of an Ultrasound machine depends on the quality of the machine and the skill of the sonographer.

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